REMARKS/ARGUMENTS

The Office Action mailed April 23, 2004 has been reviewed and carefully considered. Claims 1 and 2 have been amended and claims 10-13 are added. Claims 1-13 are pending in this application, with claims 1 and 2 being the only independent claims. Reconsideration of the above-identified application, as herein amended and in view of the following remarks, is respectfully requested.

In the Office Action mailed June 17, 2002, claims 1-9 stand rejected under 35 U.S.C. §112, second paragraph, as indefinite because the claim recites that the fuel cell at most becomes zero, but the mathematical expression uses "> 0". In accordance with the Examiner's suggestion, claims 1 and 2, and the specification, are amended to state -- U (fuel cell) = U (cathode) - U (anode) $\geq$ 0 --. In view of the amendments, the rejection of claims 1-9 under 35 U.S.C. §112, second paragraph, should now be withdrawn.

Claims 1-3 and 8 stand rejected under 35 U.S.C. §102(b) as anticipated by Fedkiw et al., *Pulsed-Potential Oxidation of Methanol*, J. Electrochem. Soc., October 1988 (Fedkiw).

Claims 4-7 and 9 stand rejected under 35 U.S.C. §103 as unpatentable over Fedkiw in view of Applicant's Admitted Prior Art.

Before discussing the cited prior art and the Examiner's rejections of the claims in view of that art, a brief summary of the present invention is appropriate. The present invention relates to a fuel cell in which power loss caused by contaminants adsorbed at the anode catalyst is avoided. According to the present invention, a fuel cell having an anode-cathode unit includes an anode catalyst and means for impressing a positive voltage on the anode of the fuel cell (see page 4, lines 6-8, and page 7, lines 3-4 of the specification). The means for impressing a positive voltage on the anode is operated so that the fuel cell voltage does not change sign and at most becomes zero so

that U (fuel cell) = U (cathode) - U (anode) $\geq$ 0 (see page 4, lines 9-11). Furthermore, the magnitude of the voltage of the voltage pulse is chosen during operation such that carbon monoxide adsorbed at the anode catalyst is oxidized (page 4, lines 12-15)

Independent claims 1 and 2 recite that "impressing a positive voltage pulse on the anode, wherein the fuel cell has a voltage that does not change sign and at most becomes zero so that U (fuel cell) = U (cathode) - U (anode) $\geq$ 0".

Fedkiw discloses applying a pulsed waveform to an anode. According to Fedkiw, the oxidation rate of methanol on a clean platinum anode is initially large, but decays quickly as the reaction proceeds due to a partial oxidation product which builds up on the surface and effectively poisons the electrode (p. 2459, left col., lines 15-19, in Fedkiw). The poison may be oxidized and removed from the electrode, but only at anodic polarizations that are unacceptable for fuel cell usage (p.2459, left col., lines 34-37). According to Fedkiw, a periodic pulsed-potential waveform is potenstatically applied which alternates from a high anodic polarization V_H of duration t_H to a low anodic polarization V_L of duration t_L (p. 2459, left col., lines 34-37).

Fedkiw describes two specific implementations in which a V_L of 0.4 and 0.6V is applied with a V_H of 1.18 (page 2460, left col., lines 1-2). The particular fuel cell on which these test voltages were applied has an equilibrium potential of V_{oc} = 1.21V (see page 2459, left col., lines 1-2; page 2463, left col., lines 20-21; and page 2463, the caption of Fig. 9). Attached hereto is an article available on the World Wide Web entitled "Fuel Cell Research". The section starting on page 3 of this article entitled "Actual Performance of a Fuel Cell", describes that the actual cell potential is decreased from the equilibrium potential because of irreversible losses including activation polarization, ohmic polarization, and concentration polarization. As shown

in the graph in the article, the total loss is dependent on the current density. In the example shown in the attachment, the equilibrium potential is approximately 1.2V. The operating voltage decreases as the current density increases and is typically in the range of 0.5 to 1.0V.

The Examiner states that voltage V_{oc} in Fedkiw is a standard voltage. However, the above-cited sections (page 2459, left col., lines 1-2; page 2463, left col., lines 20-21) of Fedkiw reveal that V_{oc} is the equilibrium potential. Since V_H is only 0.03 less that the equilibrium potential, and since the attached article indicates that the operating voltage is typically more than .2 volts less than the equilibrium, the applied 1.18 volts at the anode would be greater than the operating voltage for most, if not all, of the operating range of current. Accordingly, Fedkiw fails to teach or suggest "impressing a positive voltage pulse on the anode, wherein the fuel cell has a voltage that does not change sign and at most becomes zero so that U (fuel cell) = U (cathode) - U (anode) $\geq$ 0", as expressly recited in independent claims 1 and 2.

Dependent claims 3-13, each being dependent on one of independent claims 1 and 2, are deemed allowable for at least the same reasons expressed above with respect to independent claims 1 and 2.

New claims 10 and 11 are added to recite that the "magnitude of the voltage of the voltage pulse is chosen during operation to oxidize carbon monoxide adsorbed at the anode catalyst". Support for this limitation is found at page 4, lines 13-15, in the specification. Since the actual operating voltage of the cell changes in response to the current density, the magnitude of the pulse must be adjusted so that it is sufficient to oxidize carbon monoxide adsorbed at the anode catalyst and so that it meets the requirements of the formula in claims 1 and 2. Fedkiw fails to teach or suggest choosing the voltage magnitude during operation, as now recited in claims 10 and 11. Accordingly, claims 10 and 11 are allowable over Fedkiw for these additional reasons.

New claims 12 and 13 are added to recite "varying a time period of the repeated positive voltage pulses in response to load changes." Support for these limitations is found on page 5, lines 12-13 of the specification. Fedkiw fails to teach or suggest changing or varying a time period of the pulses based on a load change, as now recited in claims 12 and 13. Accordingly, it is respectfully submitted that new claims 12 and 13 are allowable over Fedkiw for these additional reasons.

The application is now deemed to be in condition for allowance and notice to that effect is solicited.

Respectfully submitted,

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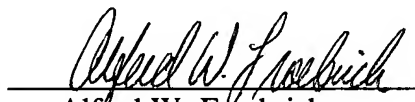
By 

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